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IntegrAda 4.1.0, R.R. Software, Inc., Wright-Patterson AFB, Compaq Deskpro 286 under MS DOS 3.10 (Host and Target), ACVC 1.10

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Compiler Name: IntegrAda 4.1.0

Certificate Number: 890113W1.10024

Host: Compaq Deskpro 286 under MS DOS 3.10

Target: Compaq Deskpro 286 under MS DOS 3.10

Testing Completed 13 January 1989 Using ACVC 1.10

This report has been reviewed and is approved.



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VALIDATION SUMMARY REPORT:
Certificate Number: 890113W1.10024
R.R. Software, Inc.
IntegrAda 4.1.0
Compaq Deskpro 286 Host and Target

Completion of On-Site Testing:
13 January 1989

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Washington DC 20301-3081

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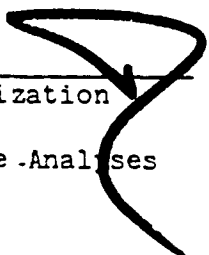
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CHAPTER 1

INTRODUCTION

This Validation Summary Report ^(VSR) describes the extent to which a specific Ada compiler conforms to the Ada Standard, ANSI/MIL-STD-1815A. This report explains all technical terms used within it and thoroughly reports the results of testing this compiler using the Ada Compiler Validation Capability (ACVC). An Ada compiler must be implemented according to the Ada Standard, and any implementation-dependent features must conform to the requirements of the Ada Standard. The Ada Standard must be implemented in its entirety, and nothing can be implemented that is not in the Standard.

Even though all validated Ada compilers conform to the Ada Standard, it must be understood that some differences do exist between implementations. The Ada Standard permits some implementation dependencies--for example, the maximum length of identifiers or the maximum values of integer types. Other differences between compilers result from the characteristics of particular operating systems, hardware, or implementation strategies. All the dependencies observed during the process of testing this compiler are given in this report.

The information in this report is derived from the test results produced during validation testing. The validation process includes submitting a suite of standardized tests, the ACVC, as inputs to an Ada compiler and evaluating the results. The purpose of validating is to ensure conformity of the compiler to the Ada Standard by testing that the compiler properly implements legal language constructs and that it identifies and rejects illegal language constructs. The testing also identifies behavior that is implementation dependent, but is permitted by the Ada Standard. Six classes of tests are used. These tests are designed to perform checks at compile time, at link time, and during execution.

1.1 PURPOSE OF THIS VALIDATION SUMMARY REPORT

This VSR documents the results of the validation testing performed on an Ada compiler. Testing was carried out for the following purposes:

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- . To attempt to identify any language constructs supported by the compiler that do not conform to the Ada Standard
- . To attempt to identify any language constructs not supported by the compiler but required by the Ada Standard
- . To determine that the implementation-dependent behavior is allowed by the Ada Standard

Testing of this compiler was conducted by SofTech, Inc. under the direction of the AVF according to procedures established by the Ada Joint Program Office and administered by the Ada Validation Organization (AVO). On-site testing was completed 13 January 1989 at Madison WI.

1.2 USE OF THIS VALIDATION SUMMARY REPORT

Consistent with the national laws of the originating country, the AVO may make full and free public disclosure of this report. In the United States, this is provided in accordance with the "Freedom of Information Act" (5 U.S.C. #552). The results of this validation apply only to the computers, operating systems, and compiler versions identified in this report.

The organizations represented on the signature page of this report do not represent or warrant that all statements set forth in this report are accurate and complete, or that the subject compiler has no nonconformities to the Ada Standard other than those presented. Copies of this report are available to the public from:

Ada Information Clearinghouse
Ada Joint Program Office
OUSDRE
The Pentagon, Rm 3D-139 (Fern Street)
Washington DC 20301-3081

or from:

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Questions regarding this report or the validation test results should be directed to the AVF listed above or to:

Ada Validation Organization
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1.3 REFERENCES

Reference Manual for the Ada Programming Language,
ANSI/MIL-STD-1815A, February 1983 and ISO 8652-1987.

Ada Compiler Validation Procedures and Guidelines, Ada Joint
Program Office, 1 January 1987.

Ada Compiler Validation Capability Implementers' Guide, SofTech,
Inc., December 1986.

Ada Compiler Validation Capability User's Guide, December 1986.

1.4 DEFINITION OF TERMS

| | |
|-------------------|---|
| ACVC | The Ada Compiler Validation Capability. The set of Ada programs that tests the conformity of an Ada compiler to the Ada programming language. |
| Ada Commentary | An Ada Commentary contains all information relevant to the point addressed by a comment on the Ada Standard. These comments are given a unique identification number having the form AI-ddddd. |
| Ada Standard | ANSI/MIL-STD-1815A, February 1983 and ISO 8652-1987. |
| Applicant | The agency requesting validation. |
| AVF | The Ada Validation Facility. The AVF is responsible for conducting compiler validations according to procedures contained in the <u>Ada Compiler Validation Procedures and Guidelines</u> . |
| AVO | The Ada Validation Organization. The AVO has oversight authority over all AVF practices for the purpose of maintaining a uniform process for validation of Ada compilers. The AVO provides administrative and technical support for Ada validations to ensure consistent practices. |
| Compiler | A processor for the Ada language. In the context of this report, a compiler is any language processor, including cross-compilers, translators, and interpreters. |
| Failed test | An ACVC test for which the compiler generates a result that demonstrates nonconformity to the Ada Standard. |
| Host | The computer on which the compiler resides. |

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| | |
|-------------------|--|
| Inapplicable test | An ACVC test that uses features of the language that a compiler is not required to support or may legitimately support in a way other than the one expected by the test. |
| Passed test | An ACVC test for which a compiler generates the expected result. |
| Target | The computer which executes the code generated by the compiler. |
| Test | A program that checks a compiler's conformity regarding a particular feature or a combination of features to the Ada Standard. In the context of this report, the term is used to designate a single test, which may comprise one or more files. |
| Withdrawn test | An ACVC test found to be incorrect and not used to check conformity to the Ada Standard. A test may be incorrect because it has an invalid test objective, fails to meet its test objective, or contains illegal or erroneous use of the language. |

1.5 ACVC TEST CLASSES

Conformity to the Ada Standard is measured using the ACVC. The ACVC contains both legal and illegal Ada programs structured into six test classes: A, B, C, D, E, and L. The first letter of a test name identifies the class to which it belongs. Class A, C, D, and E tests are executable, and special program units are used to report their results during execution. Class B tests are expected to produce compilation errors. Class L tests are expected to produce errors because of the way in which a program library is used at link time.

Class A tests ensure the successful compilation and execution of legal Ada programs with certain language constructs which cannot be verified at run time. There are no explicit program components in a Class A test to check semantics. For example, a Class A test checks that reserved words of another language (other than those already reserved in the Ada language) are not treated as reserved words by an Ada compiler. A Class A test is passed if no errors are detected at compile time and the program executes to produce a PASSED message.

Class B tests check that a compiler detects illegal language usage. Class B tests are not executable. Each test in this class is compiled and the resulting compilation listing is examined to verify that every syntax or semantic error in the test is detected. A Class B test is passed if every illegal construct that it contains is detected by the compiler.

Class C tests check the run time system to ensure that legal Ada programs can be correctly compiled and executed. Each Class C test is self-checking and produces a PASSED, FAILED, or NOT APPLICABLE message indicating the result when it is executed.

Class D tests check the compilation and execution capacities of a compiler. Since there are no capacity requirements placed on a compiler by the Ada Standard for some parameters--for example, the number of identifiers permitted in a compilation or the number of units in a library--a compiler may refuse to compile a Class D test and still be a conforming compiler. Therefore, if a Class D test fails to compile because the capacity of the compiler is exceeded, the test is classified as inapplicable. If a Class D test compiles successfully, it is self-checking and produces a PASSED or FAILED message during execution.

Class E tests are expected to execute successfully and check implementation-dependent options and resolutions of ambiguities in the Ada Standard. Each Class E test is self-checking and produces a NOT APPLICABLE, PASSED, or FAILED message when it is compiled and executed. However, the Ada Standard permits an implementation to reject programs containing some features addressed by Class E tests during compilation. Therefore, a Class E test is passed by a compiler if it is compiled successfully and executes to produce a PASSED message, or if it is rejected by the compiler for an allowable reason.

Class L tests check that incomplete or illegal Ada programs involving multiple, separately compiled units are detected and not allowed to execute. Class L tests are compiled separately and execution is attempted. A Class L test passes if it is rejected at link time--that is, an attempt to execute the main program must generate an error message before any declarations in the main program or any units referenced by the main program are elaborated. In some cases, an implementation may legitimately detect errors during compilation of the test.

Two library units, the package REPORT and the procedure CHECK_FILE, support the self-checking features of the executable tests. The package REPORT provides the mechanism by which executable tests report PASSED, FAILED, or NOT APPLICABLE results. It also provides a set of identity functions used to defeat some compiler optimizations allowed by the Ada Standard that would circumvent a test objective. The procedure CHECK_FILE is used to check the contents of text files written by some of the Class C tests for Chapter 14 of the Ada Standard. The operation of REPORT and CHECK_FILE is checked by a set of executable tests. These tests produce messages that are examined to verify that the units are operating correctly. If these units are not operating correctly, then the validation is not attempted.

The text of each test in the ACVC follows conventions that are intended to ensure that the tests are reasonably portable without modification. For example, the tests make use of only the basic set of 55 characters, contain lines with a maximum length of 72 characters, use small numeric values, and place features that may not be supported by all implementations in separate tests. However, some tests contain values that require the test to be

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customized according to implementation-specific values--for example, an illegal file name. A list of the values used for this validation is provided in Appendix C.

A compiler must correctly process each of the tests in the suite and demonstrate conformity to the Ada Standard by either meeting the pass criteria given for the test or by showing that the test is inapplicable to the implementation. The applicability of a test to an implementation is considered each time the implementation is validated. A test that is inapplicable for one validation is not necessarily inapplicable for a subsequent validation. Any test that was determined to contain an illegal language construct or an erroneous language construct is withdrawn from the ACVC and, therefore, is not used in testing a compiler. The tests withdrawn at the time of this validation are given in Appendix D.

CHAPTER 2
CONFIGURATION INFORMATION

2.1 CONFIGURATION TESTED

The candidate compilation system for this validation was tested under the following configuration:

Compiler: IntegrAda 4.1.0

ACVC Version: 1.10

Certificate Number: 890113W1.10024

Host Computer:

Machine: Compaq Deskpro 286

Operating System: MS DOS 3.10

Memory Size: 2176 Kbytes

Target Computer:

Machine: Compaq Deskpro 286

Operating System: MS DOS 3.10

Memory Size: 2176 Kbytes

CONFIGURATION INFORMATION

2.2 IMPLEMENTATION CHARACTERISTICS

One of the purposes of validating compilers is to determine the behavior of a compiler in those areas of the Ada Standard that permit implementations to differ. Class D and E tests specifically check for such implementation differences. However, tests in other classes also characterize an implementation. The tests demonstrate the following characteristics:

a. Capacities.

- (1) The compiler correctly processes a compilation containing 723 variables in the same declarative part. (See test D29002K.)
- (2) The compiler correctly processes tests containing loop statements nested to 17 levels. (See tests D55A03A..H (8 tests).)
- (3) The compiler rejects tests containing block statements nested to 65 levels. (See test D56001B.)
- (4) The compiler correctly processes tests containing recursive procedures separately compiled as subunits nested to six levels. (See tests D64005E..G (3 tests).)

b. Predefined types.

- (1) This implementation supports the additional predefined types `LONG_INTEGER` and `LONG_FLOAT` in the package `STANDARD`. (See tests B86001T..Z (7 tests).)

c. Expression evaluation.

The order in which expressions are evaluated and the time at which constraints are checked are not defined by the language. While the ACVC tests do not specifically attempt to determine the order of evaluation of expressions, test results indicate the following:

- (1) Not all of the default initialization expressions for record components are evaluated before any value is checked for membership in a component's subtype. (See test C32117A.)
- (2) Assignments for subtypes are performed with the same precision as the base type. (See test C35712B.)
- (3) This implementation uses no extra bits for extra precision and uses no extra bits for extra range. (See test C35903A.)

- (4) `NUMERIC_ERROR` is raised when a literal operand in a comparison is outside the range of predefined Integer, when a literal operand in a membership test is outside the range of predefined Integer, when a literal operand in a comparison is greater than `SYSTEM.MAX_INT`, when a literal operand in a membership test is greater than `SYSTEM.MAX_INT` and no exception is raised when a literal operand in a comparison is outside the range of the integer type's base type. (See test C45232A.)
- (5) `NUMERIC_ERROR` is raised when a literal operand in a fixed point membership test is outside the range of the base type and no exception is raised when a literal operand in a fixed point comparison is outside the range of the base type. (See test C45252A.)
- (6) Underflow is gradual. (See tests C45524A..Z (26 tests).)

d. Rounding.

The method by which values are rounded in type conversions is not defined by the language. While the ACVC tests do not specifically attempt to determine the method of rounding, the test results indicate the following:

- (1) The method used for rounding to integer is round away from zero. (See tests C46012A..Z (26 tests).)
- (2) The method used for rounding to longest integer is round away from zero. (See tests C46012A..Z (26 tests).)
- (3) The method used for rounding to integer in static universal real expressions is round away from zero. (See test C4A014A.)

e. Array types.

An implementation is allowed to raise `NUMERIC_ERROR` or `CONSTRAINT_ERROR` for an array having a `'LENGTH` that exceeds `STANDARD.INTEGER'LAST` and/or `SYSTEM.MAX_INT`. For this implementation:

- (1) Declaration of an array type or subtype declaration with more than `SYSTEM.MAX_INT` components raises no exception. (See test C36003A.)

CONFIGURATION INFORMATION

- (2) `CONSTRAINT_ERROR` is raised when 'LENGTH' is applied to an array type with `INTEGER'LAST + 2` components. (See test C36202A.)
- (3) `NUMERIC_ERROR` is raised when 'LENGTH' is applied to an array type with `SYSTEM.MAX_INT + 2` components. (See test C36202B.)
- (4) A packed `BOOLEAN` array having a 'LENGTH' exceeding `INTEGER'LAST` raises `STORAGE_ERROR` when the array objects are declared. (See test C52103X.)
- (5) A packed two-dimensional `BOOLEAN` array with more than `INTEGER'LAST` components raises `CONSTRAINT_ERROR` when the length of a dimension is calculated and exceeds `INTEGER'LAST`. (See test C52104Y.)
- (6) A null array with one dimension of length greater than `INTEGER'LAST` may raise `NUMERIC_ERROR` or `CONSTRAINT_ERROR` either when declared or assigned. Alternatively, an implementation may accept the declaration. However, lengths must match in array slice assignments. This implementation raises no exception. (See test E52103Y.)
- (7) In assigning one-dimensional array types, the expression is evaluated in its entirety before `CONSTRAINT_ERROR` is raised when checking whether the expression's subtype is compatible with the target's subtype. (See test C52013A.)
- (8) In assigning two-dimensional array types, the expression is not evaluated in its entirety before `CONSTRAINT_ERROR` is raised when checking whether the expression's subtype is compatible with the target's subtype. (See test C52013A.)

f. Discriminated types.

- (1) In assigning record types with discriminants, the expression is evaluated in its entirety before `CONSTRAINT_ERROR` is raised when checking whether the expression's subtype is compatible with the target's subtype. (See test C52013A.)

g. Aggregates.

- (1) In the evaluation of a multi-dimensional aggregate, the test results indicate that index subtype checks are made as choices are evaluated. (See tests C43207A and C43207B.)

- (2) In the evaluation of an aggregate containing subaggregates, not all choices are evaluated before being checked for identical bounds. (See test E43212B.)
- (3) CONSTRAINT_ERROR is raised before all choices are evaluated when a bound in a non-null range of a non-null aggregate does not belong to an index subtype. (See test E43211B.)

h. Pragmas.

- (1) The pragma INLINE is not supported for functions or procedures. (See tests LA3004A..B (2 tests), EA3004C..D (2 tests), and CA3004E..F (2 tests).)

i. Generics.

- (1) Generic specifications and bodies can be compiled in separate compilations. (See tests CA1012A, CA2009C, CA2009F, BC3204C, and BC3205D.)
- (2) Generic unit bodies and their subunits can be compiled in separate compilations. (See test CA3011A.)
- (3) Generic subprogram declarations and bodies can be compiled in separate compilations. (See tests CA1012A and CA2009F.)
- (4) Generic library subprogram specifications and bodies can be compiled in separate compilations. (See test CA1012A.)
- (5) Generic non-library subprogram bodies can be compiled in separate compilations from their stubs. (See test CA2009F.)
- (6) Generic package declarations and bodies can be compiled in separate compilations. (See tests CA2009C, BC3204C, and BC3205D.)
- (7) Generic library package specifications and bodies can be compiled in separate compilations. (See tests BC3204C and BC3205D.)
- (8) Generic non-library package bodies as subunits can be compiled in separate compilations. (See test CA2009C.)
- (9) Generic unit bodies and their subunits can be compiled in separate compilations. (See test CA3011A.)

CONFIGURATION INFORMATION

j. Input and output.

- (1) The package `SEQUENTIAL_IO` can be instantiated with unconstrained array types and record types with discriminants without defaults. (See tests `AE2101C`, `EE2201D`, and `EE2201E`.)
- (2) The package `DIRECT_IO` can be instantiated with unconstrained array types and record types with discriminants without defaults. (See tests `AE2101H`, `EE2401D`, and `EE2401G`.)
- (3) Modes `IN_FILE` and `OUT_FILE` are supported for `SEQUENTIAL_IO`. (See tests `CE2102D..E`, `CE2102N`, and `CE2102P`.)
- (4) Modes `IN_FILE`, `OUT_FILE`, and `INOUT_FILE` are supported for `DIRECT_IO`. (See tests `CE2102F`, `CE2102I..J` (2 tests), `CE2102R`, `CE2102T`, and `CE2102V`.)
- (5) Modes `IN_FILE` and `OUT_FILE` are supported for text files. (See tests `CE3102E` and `CE3102I..K` (3 tests).)
- (6) `RESET` and `DELETE` operations are supported for `SEQUENTIAL_IO`. (See tests `CE2102G` and `CE2102X`.)
- (7) `RESET` and `DELETE` operations are supported for `DIRECT_IO`. (See tests `CE2102K` and `CE2102Y`.)
- (8) `RESET` and `DELETE` operations are supported for text files. (See tests `CE3102F..G` (2 tests), `CE3104C`, `CE3110A`, and `CE3114A`.)
- (9) Overwriting to a sequential file does not truncate the file. (See test `CE2208B`.)
- (10) Temporary sequential files are not given names and not deleted when closed. (See test `CE2108A`.)
- (11) Temporary direct files are not given names and not deleted when closed. (See test `CE2108C`.)
- (12) Temporary text files are not given names and not deleted when closed. (See test `CE3112A`.)
- (13) Only one internal file can be associated with each external file for sequential files when at least one of the internal files has write access. (See tests `CE2107A..E` (5 tests), `CE2102L`, `CE2110B`, and `CE2111D`.)
- (14) Only one internal file can be associated with each external file for direct files when at least one of the internal files has write access. (See tests `CE2107F..H` (3 tests), `CE2110D` and `CE2111H`.)

- (15) Only one internal file can be associated with each external file for text files when at least one of the internal files has write access. (See tests CE3111A..E (5 tests), CE3114B, and CE3115A.)

CHAPTER 3

TEST INFORMATION

3.1 TEST RESULTS

Version 1.10 of the ACVC comprises 3717 tests. When this compiler was tested, 36 tests had been withdrawn because of test errors. The AVF determined that 380 tests were inapplicable to this implementation. All inapplicable tests were processed during validation testing except for 201 executable tests that use floating-point precision exceeding that supported by the implementation. Modifications to the code, processing, or grading for 36 tests were required to successfully demonstrate the test objective. (See section 3.6.)

The AVF concludes that the testing results demonstrate acceptable conformity to the Ada Standard.

3.2 SUMMARY OF TEST RESULTS BY CLASS

| RESULT | TEST CLASS | | | | | | TOTAL |
|--------------|------------|------|------|----|----|----|-------|
| | A | B | C | D | E | L | |
| Passed | 128 | 1131 | 1959 | 10 | 29 | 44 | 3301 |
| Inapplicable | 1 | 7 | 358 | 7 | 5 | 2 | 380 |
| Withdrawn | 1 | 2 | 33 | 0 | 0 | 0 | 36 |
| TOTAL | 130 | 1140 | 2350 | 17 | 34 | 46 | 3717 |

TEST INFORMATION

3.3 SUMMARY OF TEST RESULTS BY CHAPTER

| RESULT | CHAPTER | | | | | | | | | | | | | | TOTAL |
|--------|---------|-----|-----|-----|-----|----|-----|-----|-----|----|-----|-----|-----|------|-------|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | | |
| Passed | 199 | 576 | 544 | 240 | 170 | 99 | 160 | 332 | 131 | 36 | 251 | 281 | 282 | 3301 | |
| N/A | 14 | 73 | 136 | 8 | 2 | 0 | 6 | 1 | 6 | 0 | 1 | 94 | 39 | 380 | |
| Wdrn | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 29 | 4 | 36 | |
| TOTAL | 213 | 650 | 680 | 248 | 172 | 99 | 166 | 334 | 137 | 36 | 253 | 404 | 325 | 3717 | |

3.4 WITHDRAWN TESTS

The following 36 tests were withdrawn from ACVC Version 1.10 at the time of this validation:

| | | | | | |
|------------|------------|---------|---------|------------|------------|
| A39005G | B97102E | BC3009B | CD2A62D | CD2A63A..D | CD2A66A..D |
| CD2A73A..D | CD2A76A..D | CD2A81G | CD2A83G | CD2A84M..N | CD50110 |
| CD2B15C | CD7205C | CD5007B | CD7105A | CD7203B | CD7204B |
| CD7205D | CE2107I | CE3111C | CE3301A | CE3411B | |

See Appendix D for the reason that each of these tests was withdrawn.

3.5 INAPPLICABLE TESTS

Some tests do not apply to all compilers because they make use of features that a compiler is not required by the Ada Standard to support. Others may depend on the result of another test that is either inapplicable or withdrawn. The applicability of a test to an implementation is considered each time a validation is attempted. A test that is inapplicable for one validation attempt is not necessarily inapplicable for a subsequent attempt. For this validation attempt, 380 tests were inapplicable for the reasons indicated:

- a. The following 201 tests are not applicable because they have floating-point type declarations requiring more digits than `SYSTEM.MAX_DIGITS`:

| | |
|-----------------------|-----------------------|
| C24113L..Y (14 tests) | C35705L..Y (14 tests) |
| C35706L..Y (14 tests) | C35707L..Y (14 tests) |
| C35708L..Y (14 tests) | C35802L..Z (15 tests) |

| | |
|-----------------------|-----------------------|
| C45241L..Y (14 tests) | C45321L..Y (14 tests) |
| C45421L..Y (14 tests) | C45521L..Z (15 tests) |
| C45524L..Z (15 tests) | C45621L..Z (15 tests) |
| C45641L..Y (14 tests) | C46012L..Z (15 tests) |

- b. C35702A and B86001T are not applicable because this implementation supports no predefined type `SHORT_FLOAT`.
- c. The following 30 tests are not applicable because this implementation does not support '`STORAGE_SIZE`' representation clauses for access types:

| | | | | |
|---------|---------|---------|---------|---------|
| A39005C | C87B62B | CD1009J | CD1009R | CD1009S |
| CD1C03C | CD2A83A | CD2A83B | CD2A83C | CD2A83E |
| CD2A83F | CD2A84B | CD2A84C | CD2A84D | CD2A84E |
| CD2A84F | CD2A84G | CD2A84H | CD2A84I | CD2A84K |
| CD2A84L | CD2B11B | CD2B11C | CD2B11D | CD2B11E |
| CD2B11F | CD2B11G | CD2B15B | CD2B16A | ED2A86A |

- d. The following 16 tests are not applicable because this implementation does not support a predefined type `SHORT_INTEGER`:

| | | | | |
|---------|---------|---------|---------|---------|
| C45231B | C45304B | C45502B | C45503B | C45504B |
| C45504E | C45611B | C45613B | C45614B | C45631B |
| C45632B | B52004E | C55B07B | B55B09D | B86001V |
| CD7101E | | | | |

- e. B86001X, C45231D, and CD7101G are not applicable because this implementation does not support any predefined integer type with a name other than `INTEGER`, `LONG_INTEGER`, or `SHORT_INTEGER`.
- f. B86001Y is not applicable because this implementation supports no predefined fixed-point type other than `DURATION`.
- g. B86001Z is not applicable because this implementation supports no predefined floating-point type with a name other than `FLOAT`, `LONG_FLOAT`, or `SHORT_FLOAT`.
- h. C45531M..P (4 tests) and C45532M..P (4 tests) are not applicable because the value of `SYSTEM.MAX_MANTISSA` is less than 32.
- i. D55A03E..H (4 tests) use 31 levels of loop nesting which exceeds the capacity of the compiler.
- j. D56001B uses 65 levels of block nesting which exceeds the capacity of the compiler.
- k. D64005F..G (2 tests) are not applicable because this implementation does not support nesting 10 levels of recursive procedure calls.

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- l. C96005B is not applicable because there are no values of type DURATION'BASE that are outside the range of DURATION.
- m. LA3004A, LA3004B, EA3004C, EA3004D, CA3004E, and CA3004F are not applicable because this implementation does not support pragma INLINE.
- n. CC1223A contains an expression that is expected to be static, but which this implementation treats as non-static; thus, this implementation raises an exception rather than providing exact evaluation. The AVO agreed that this issue of staticness within a generic unit requires further review.
- o. The following 51 tests are not applicable because this implementation does not support 'SIZE representation clauses for floating point, one dimensional array, and record types:

| | | | | |
|---------|---------|---------|---------|---------|
| CD1009C | CD2A41A | CD2A41B | CD2A41E | CD2A42A |
| CD2A42B | CD2A42C | CD2A42D | CD2A42E | CD2A42F |
| CD2A42G | CD2A42H | CD2A42I | CD2A42J | CD2A61A |
| CD2A61B | CD2A61C | CD2A61D | CD2A61F | CD2A61H |
| CD2A61I | CD2A61J | CD2A61K | CD2A61L | CD2A62A |
| CD2A62B | CD2A62C | CD2A64A | CD2A64B | CD2A64C |
| CD2A64D | CD2A65A | CD2A65B | CD2A65C | CD2A65D |
| CD2A71A | CD2A71B | CD2A71C | CD2A71D | CD2A72A |
| CD2A72B | CD2A72C | CD2A72D | CD2A74A | CD2A74B |
| CD2A74C | CD2A74D | CD2A75A | CD2A75B | CD2A75C |
| CD2A75D | | | | |

- p. The following 13 tests are not applicable because this implementation does not support record representation clauses:

| | | | | |
|---------|---------|---------|---------|---------|
| CD1009N | CD1009X | CD1009Y | CD1009Z | CD1C03H |
| CD1C04E | CD4031A | CD4041A | CD4051A | CD4051B |
| CD4051C | CD4051D | ED1D04A | | |

- q. CE2102D..F (3 tests), CE2102I..J (2 tests), CE2102N..W (10 tests), CE3102E..G (3 tests), and CE3102I..K (3 tests) are not applicable because this implementation supports CREATE (all modes), OPEN (all modes), and RESET (to the same mode) for sequential, direct, and text files.
- r. CE2107B..E (4 tests), CE2107L, CE2110B, CE2111D, CE2107G..H (2 tests), CE2110D, CE2111H, CE3111B, CE3111D..E (2 tests), CE3114B, and CE3115A are not applicable because this implementation does not permit the association of multiple internal files with the same external file when one of the internal files has write access to the external file. The proper exception is raised when multiple access is attempted.

- s. EE2201D and EE2401D are not applicable because USE_ERROR is raised when trying to create a file with unconstrained array types.

3.6 TEST, PROCESSING, AND EVALUATION MODIFICATIONS

It is expected that some tests will require modifications of code, processing, or evaluation in order to compensate for legitimate implementation behavior. Modifications are made by the AVF in cases where legitimate implementation behavior prevents the successful completion of an (otherwise) applicable test. Examples of such modifications include: adding a length clause to alter the default size of a collection; splitting a Class B test into subtests so that all errors are detected; and confirming that messages produced by an executable test demonstrate conforming behavior that was not anticipated by the test (such as raising one exception instead of another).

Modifications were required for 36 tests.

The following tests were split because syntax errors at one point resulted in the compiler not detecting other errors in the test:

| | | | | | |
|---------|---------|---------|---------|---------|---------|
| B22003A | B24007A | B24009A | B25002A | B26005A | B27005A |
| B29001A | B37106A | B49003A | B49005A | B51001A | B53003A |
| B55A01A | B63001A | B63001B | B91001H | BA1101A | BA1101C |
| BA1101E | BA3006A | BA3006B | BA3007B | BA3008A | BA3008B |
| BA3013A | BC2001D | BC2001E | BC3005B | | |

The following modifications were made to compensate for legitimate implementation behavior:

- a. At the recommendation of the AVO, a "PRAGMA ELABORATE (REPORT);" was added at the beginning of C39005A to ensure that the elaboration of the routines in package REPORT takes place before these routines are called.
- b. At the recommendation of the AVO, the variables V and W on line 41 of test CD2C11A were initialized to 5.0 due to PROGRAM_ERROR being raised when an attempt is made to use the uninitialized variables.
- c. At the recommendation of the AVO, LONG_INTEGER'IMAGE was substituted for INTEGER'IMAGE in test ED7006C since SYSTEM.MEMORY_SIZE is outside the range of INTEGER for this implementation.
- d. At the recommendation of the AVO, the lines which check whether temporary files can be created in tests CE2108B, CE2108D, and CE3112B were commented out because of the way in which temporary

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file names are constructed.

The following tests were graded using a modified evaluation criteria:

- a. In test C34006D, the meaning of 'SIZE applied to a type is not clear. The test is graded PASSED provided the only failure messages arise from the requirements on the value of T'SIZE, where T is a type.
- b. CE3804G writes, then reads, a floating-point literal and tests the input value against a textually identical literal; this implementation stores the numeric literal with greater precision than it uses for objects of the type, and because the literal is not a model number the test for equality at line 121 fails. The AVO ruled that CE3804G should be counted as passed, for all of its other checks were passed.

3.7 ADDITIONAL TESTING INFORMATION

3.7.1 Prevalidation

Prior to validation, a set of test results for ACVC Version 1.10 produced by the IntegrAda 4.1.0 compiler was submitted to the AVF by the applicant for review. Analysis of these results demonstrated that the compiler successfully passed all applicable tests, and the compiler exhibited the expected behavior on all inapplicable tests.

3.7.2 Test Method

Testing of the IntegrAda 4.1.0 compiler using ACVC Version 1.10 was conducted on-site by a validation team from the AVF. The configuration in which the testing was performed is described by the following designations of hardware and software components:

| | |
|--------------------------|--------------------|
| Host computer: | Compaq Deskpro 286 |
| Host operating system: | MS DOS 3.10 |
| Target computer: | Compaq Deskpro 286 |
| Target operating system: | MS DOS 3.10 |
| Compiler: | IntegrAda 4.1.0 |

A set of 45 diskettes containing all tests except for withdrawn tests and tests requiring unsupported floating-point precisions was taken on-site by the validation team for processing. Tests that make use of implementation-specific values were customized before being written to the diskettes. Tests requiring modifications during the prevalidation testing

were included in their modified form on the diskettes.

The contents of the diskettes were loaded directly onto the host computer.

After the test files were loaded to disk, the full set of tests was compiled, linked, and all executable tests were run on the Compaq Deskpro 286. Results were printed from the host computer.

The compiler was tested using command scripts provided by R.R. Software, Inc. and reviewed by the validation team. The compiler was tested using the following default option settings:

| <u>OPTION</u> | <u>EFFECT</u> |
|---------------|--|
| /B | Error messages are verbose. |
| /F | Library calls are generated for floating point operations. |
| /L | No listing file is generated. |
| /O | Memory model 0 is used. |
| /R | The JRL file is put on the same disk as the input file. |
| /X | Extra symbol table information is not generated. |
| /Z | Optimization is done only where so specified by pragmas. |

The following option settings were used instead of the defaults:

| <u>OPTION</u> | <u>EFFECT</u> |
|---------------|---|
| /Q | Quiet error messages - suppresses user prompting on errors. |
| /W | Warnings off - warnings were suppressed mainly because of the confusing warnings that the validation tests produce. |
| /T | Trimming code on - this directs the compiler to generate code which allows the linker to trim unused subprograms. |
| /D | Debugging code off - this directs the compiler not to generate any debugging code (generally line numbers & walkbacks). |
| /SF | Used to re-direct the compiler scratch files |

TEST INFORMATION

into a RAM disk (disk F), thus speeding up the compiles.

Tests were compiled, linked, and executed (as appropriate) using a single computer. Test output, compilation listings, and job logs were captured on diskette and archived at the AVF. The listings examined on-site by the validation team were also archived.

3.7.3 Test Site

Testing was conducted at Madison WI and was completed on 13 January 1989.

APPENDIX A

DECLARATION OF CONFORMANCE

R.R. Software, Inc. has submitted the following
Declaration of Conformance concerning the IntegrAda
4.1.0 compiler.

DECLARATION OF CONFORMANCE

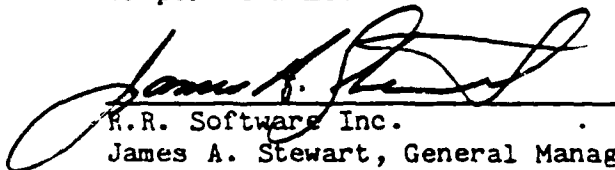
Compiler Implementor: R.R. Software Inc.
Ada®Validation Facility: ASD/SCEL, Wright-Patterson AFB, OH 45433-6503
Ada Compiler Validation Capability (ACVC) Version: 1.10

Base Configuration

Base Compiler Name: IntegrAda Version: Version 4.1.0
Host Architecture ISA: Compaq Deskpro 286 OS&VER #:MS DOS 3.1
Target Architecture ISA:Compaq Deskpro 286 OS&VER #:MS DOS 3.1

Implementor's Declaration

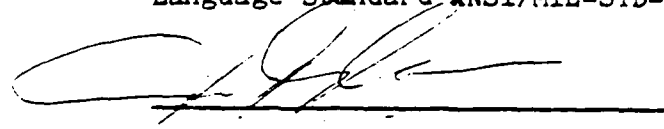
I, the undersigned, representing R.R. Software Inc., have implemented no deliberate extensions to the Ada Language Standard ANSI/MIL-STD-1815A in the compiler(s) listed in this declaration. I declare that R.R. Software Inc. is the owner of record of the Ada language compiler(s) listed above and, as such, is responsible for maintaining said compiler(s) in conformance to ANSI/MIL-STD-1815A. All certificates and registrations for Ada language compiler(s) listed in this declaration shall be made only in the owner's corporate name.


R.R. Software Inc.
James A. Stewart, General Manager

Date: January 16, 1989

Owner's Declaration

I, the undersigned, representing AETECH, INC., take full responsibility for implementation and maintenance of the Ada compiler(s) listed above, and agree to the public disclosure of the final Validation Summary Report. I further agree to continue to comply with the Ada trademark policy, as defined by the Ada Joint Program Office. I declare that all of the Ada language compilers listed, and their host/target performance are in compliance with the Ada Language Standard ANSI/MIL-STD-1815A.


AETECH, INC.
James Thomes, President

Date: January 24, 1989

©Ada is a registered trademark of the United States Government
(Ada Joint Program Office).

AVF Control Number: AVF-VSR-217.0589
88-09-23-RRS

Ada COMPILER
VALIDATION SUMMARY REPORT:
Certificate Number: 890113W1.10021
R.R. Software, Inc.
JANUS/Ada 2.1.1
PC's Limited 386 Host and Target

Completion of On-Site Testing:
13 January 1989

Prepared By:
Ada Validation Facility
ASD/SCEL
Wright-Patterson AFB, OH 45433-6503

Prepared For:
Ada Joint Program Office
United States Department of Defense
Washington DC 20301-3081

F Implementation Dependencies

This appendix specifies certain system-dependent characteristics of JANUS/Ada, version 2.1.1, for an 80x86 target system.

F.1 Implementation Dependent Pragmas

In addition to the required Ada pragmas, JANUS/Ada also provides several others. Some of these pragmas have a *textual range*. Such pragmas set some value of importance to the compiler, usually a flag that may be On or Off. The value to be used by the compiler at a given point in a program depends on the parameter of the most recent relevant pragma in the text of the program. For flags, if the parameter is the identifier On, then the flag is on; if the parameter is the identifier Off, then the flag is off; if no such pragma has occurred, then a default value is used.

The range of a pragma - even a pragma that usually has a textual range - may vary if the pragma is not inside a compilation unit. This matters only if you put multiple compilation units in a file. The following rules apply:

- 1) If a pragma is inside a compilation unit, it affects only that unit.
- 2) If a pragma is outside a compilation unit, it affects all following compilation units in the compilation.

Certain required Ada pragmas, such as INLINE, would follow different rules; however, as it turns out, JANUS/Ada ignores all pragmas that would follow different rules.

The following system-dependent pragmas are defined by JANUS/Ada. Unless otherwise stated, they may occur anywhere that a pragma may occur.

ALL_CHECKS Takes one of two identifiers On or Off as its argument, and has a textual range. If the argument is Off, then this pragma causes suppression of arithmetic checking (like pragma ARITHCHECK - see below), range checking (like pragma RANGECHECK - see below), storage error checking, and elaboration checking. If the argument is On, then these checks are all performed as usual. Note that pragma ALL_CHECKS does not affect the status of the DEBUG pragma; for the fastest run time code (and the worst run time checking), both ALL_CHECKS and DEBUG should be turned Off and the pragma OPTIMIZE (Time) should be used. Note also that ALL_CHECKS does not affect the status of the ENUMTAB pragma. Combining check suppression using the pragma ALL_CHECKS and using the pragma SUPPRESS may cause unexpected results; it should not be done.

Appendix F: Implementation Dependencies

However, `ALL_CHECKS` may be combined with the JANUS/Ada pragmas `ARITHCHECK` and `RANGECHECK`; whichever relevant pragma has occurred most recently will determine whether a given check is performed. `ALL_CHECKS` is on by default. Turning any checks off may cause unpredictable results if execution would have caused the corresponding assumption to be violated. Checks should be off only in fully debugged and tested programs. After checks are turned off, full testing should again be done, since any program that handles an exception may expect results that will not occur if no checking is done.

ARITHCHECK Takes one of the two identifiers `On` or `Off` as its argument, and has a textual range. Where `ARITHCHECK` is on, the compiler is permitted to (and generally does) not generate checks for situations where it is permitted to raise `NUMERIC_ERROR`; these checks include overflow checking and checking for division by zero. Combining check suppression using the pragma `ARITHCHECK` and using the pragma `SUPPRESS` may cause unexpected results; it should not be done. However, `ARITHCHECK` may be combined with the JANUS/Ada pragma `ALL_CHECKS`; whichever pragma has occurred most recently will be effective. `ARITHCHECK` is on by default. Turning any checks off may cause unpredictable results if execution would have caused the corresponding assumption to be violated. Checks should be off only in fully debugged and tested programs. After checks are turned off, full testing should again be done, since any program that handles an exception may expect results that will not occur if no checking is done.

CLEANUP Takes an integer literal in the range 0..3 as its argument, and has a textual range. Using this pragma allows the JANUS/Ada run-time system to be less than meticulous about recovering temporary memory space it uses. This pragma can allow for smaller and faster code, but can be dangerous; certain constructs can cause memory to be used up very quickly. The smaller the parameter, the more danger is permitted. A value of 3 - the default value - causes the run-time system to be its usual immaculate self. A value of 0 causes no reclamation of temporary space. Values of 1 and 2 allow compromising between "cleanliness" and speed. Using values other than 3 adds some risk of your program running out of memory, especially in loops which contain certain constructs.

DEBUG Takes one of the two identifiers On or Off as its argument, and has a textual range. This pragma controls the generation of line number code and procedure name code. When DEBUG is on, such code is generated. When DEBUG is off, no line number code or procedure names are generated. This information is used by the walkback which is generated after a run-time error (e.g., an unhandled exception). The walkback is still generated when DEBUG is off, but the line numbers will be incorrect, and no subprogram names will be printed. DEBUG's initial state can be set by the command line; if no explicit option is given, then DEBUG is initially on. Turning DEBUG off saves space, but causes the loss of much of JANUS/Ada's power in describing run-time errors.

Notes:

DEBUG should only be turned off when the program has no errors. The information provided on an error when DEBUG is off is not very useful.

If DEBUG is on at the beginning of a subprogram or package specification, then it must be on at the end of the specification. Conversely, if DEBUG is off at the beginning of such a specification, it must be off at the end. If you want DEBUG to be off for an entire compilation, then you can either put a DEBUG pragma in the context clause of the compilation or you can use the appropriate compiler option.

ENUMTAB Takes one of the two identifiers On or Off as its argument, and has a textual range. This pragma controls the generation of enumeration tables. Enumeration tables are used for the attributes IMAGE, VALUE, and WIDTH, and hence to input and output enumeration values. The tables are generated when ENUMTAB is on. The state of the ENUMTAB flag is significant only at enumeration type definitions. If this pragma is used to prevent generation of a type's enumeration tables, then using the three mentioned attributes causes an erroneous program, with unpredictable results; furthermore, the type should not be used as a generic actual discrete type, and in particular TEXT_IO ENUMERATION_IO should not be instantiated for the type. If the enumeration type is not needed for any of these purposes, the tables, which use a lot of space, are unnecessary. ENUMTAB is on by default.

Appendix F: Implementation Dependencies

PAGE_LENGTH

This pragma takes a single integer literal as its argument. It says that a page break should be added to the listing after each occurrence of the given number of lines. The default page length is 32000, so that no page breaks are generated for most programs. Each page starts with a header that looks like the following:

JANUS/ADA Version 2.1.1 compiling *file* on *date* at *time*

RANGECHECK Takes one of the two identifiers On or Off as its argument, and has a textual range. Where RANGECHECK is off, the compiler is permitted to (and generally does) not generate checks for situations where it is expected to raise CONSTRAINT_ERROR; these checks include null pointer checking, discriminant checking, index checking, array length checking, and range checking. Combining check suppression using the pragma RANGECHECK and using the pragma SUPPRESS may cause unexpected results; it should not be done. However, RANGECHECK may be combined with the JANUS/Ada pragma ALL_CHECKS; whichever pragma has occurred most recently will be effective. RANGECHECK is on by default. Turning any checks off may cause unpredictable results if execution would have caused the corresponding assumption to be violated. Checks should be off only in fully debugged and tested programs. After checks are turned off, full testing should again be done, since any program that handles an exception may expect results that will not occur if no checking is done.

SYSLIB This pragma tells the compiler that the current unit is one of the standard JANUS/Ada system libraries. It takes as a parameter an integer literal in the range 1 .. 15; only the values 1 through 4 are currently used. For example, system library number 2 provides floating point support. Do not use this pragma unless you are writing a package to replace one of the standard JANUS/Ada system libraries.

VERBOSE Takes On or Off as its argument, and has a textual range. VERBOSE controls the amount of output on an error. If VERBOSE is on, the two lines preceding the error are printed, with an arrow pointing at the error. If VERBOSE is off, only the line number is printed.

VERBOSE(Off):

Line 16 at Position 5
ERROR Identifier is not defined

VERBOSE(On):

```

15: if X = 10 then
16:   Z := 10;
-----^
*ERROR* Identifier is not defined

```

The reason for this option is that an error message with VERBOSE on can take a long time to be generated, especially in a large program. VERBOSE's initial condition can be set by the compiler command line.

Several required Ada pragmas may have surprising effects in JANUS/Ada. The PRIORITY pragma may only take the value 0, since that is the only value in the range System.Priority. Specifying any OPTIMIZE pragma turns on optimization; otherwise, optimization is only done if specified on the compiler's command line. The SUPPRESS pragma is ignored unless it only has one parameter. Also, the following pragmas are always ignored: CONTROLLED, INLINE, MEMORY_SIZE, PACK, SHARED, STORAGE_UNIT, and SYSTEM_NAME. Pragma CONTROLLED is always ignored because JANUS/Ada does no automatic garbage collection; thus, the effect of pragma CONTROLLED already applies to all access types. Pragma SHARED is similarly ignored: JANUS/Ada's non-preemptive task scheduling gives the appropriate effect to all variables. The pragmas INLINE, PACK, and SUPPRESS (with two parameters) all provide recommendations to the compiler; as Ada allows, the recommendations are ignored. The pragmas MEMORY_SIZE, STORAGE_UNIT, and SYSTEM_NAME all attempt to make changes to constants in the System package; in each case, JANUS/Ada allows only one value, so that the pragma is ignored.

F.2 Implementation Dependent Attributes

JANUS/Ada does not provide any attributes other than the required Ada attributes.

F.3 Specification of the Package SYSTEM

The package System for JANUS/Ada has the following definition.

Appendix F: Implementation Dependencies

package System is

-- System package for JANUS/Ada

-- Types to define type Address.

type Word **is** range 0 .. 65536;

for Word'Size **use** 16;

type Offset_Type **is** new Word;

type Address **is** record

 Offset : Offset_Type;

 Segment : Word;

end record;

Function "+" (Left : Address; Right : Offset_Type) **Return** Address;

Function "+" (Left : Offset_Type; Right : Address) **Return** Address;

Function "-" (Left : Address; Right : Offset_Type) **Return** Address;

Function "-" (Left, Right : Address) **Return** Offset_Type;

type Name **is** (MS_DOS2);

System_Name : **constant** Name := MS_DOS2;

Storage_Unit : **constant** := 8;

Memory_Size : **constant** := 65536;

-- Note: The actual memory size of a program is determined

-- dynamically; this is the maximum number of bytes in the data

-- segment.

-- System Dependent Named Numbers:

Min_Int : **constant** := -2_147_483_648;

Max_Int : **constant** := 2_147_483_647;

Max_Digits : **constant** := 15;

Max_Mantissa : **constant** := 31;

Fine_Delta : **constant** := 2#1.0#E-31;

-- equivalently, 4.656612873077392578125E-10

Tick : **constant** := 0.01; -- Some machines have less accuracy;

-- for example, the IBM PC actually ticks about

-- every 0.06 seconds.

-- Other System Dependent Declarations

subtype Priority **is** Integer range 0..0;

type Byte **is** range 0 .. 255;

for Byte'Size **use** 8;

end System;

The type `Byte` in the `System` package corresponds to the 8-bit machine byte. The type `Word` is a 16-bit Unsigned Integer type, corresponding to a machine word.

F.4 Restrictions on Representation Clauses

If `T` is a discrete type, or a fixed point type, then the size expression can give any value between 1 and 1000 bits (subject, of course, to allowing enough bits for every possible value). For other types, the expression must give the default size for `T`.

A length clause that specifies `T'SORAGE_SIZE` for an access type is not supported; JANUS/Ada uses a single large common heap.

A length clause that specifies `T'SORAGE_SIZE` for a task type `T` is supported. Any integer value can be specified. Values smaller than 256 will be rounded up to 256 (the minimum `T'Sorage_Size`), as the Ada standard does not allow raising an exception in this case.

A length clause that specifies `T'SMALL` for a fixed point type must give a value (subject to the Ada restrictions) in the range

$2.0 \times 10^{-99} \dots 2.0 \times 10^{99}$,

inclusive.

An enumeration representation clause for a type `T` may give any integer values within the range `System.Min_Int .. System.Max_Int`. If a size length clause is not given for the type, the type's size is determined from the literals given. (If all of the literals fit in a byte, then `Byte'Size` is used; similarly for `Integer` and `Long_Integer`).

The expression in an alignment clause in a record representation clause must equal 1.

A component clause must give a storage place that is equivalent to the default value of the `POSITION` attribute for such a component.

A component clause must give a range that starts at zero and extends to one less than the size of the component.

Appendix F: Implementation Dependencies

JANUS/Ada supports address clauses on most objects. Address clauses are not allowed on parameters, generic formal parameters, and renamed objects. The address given for an object address clause may be any legal value of type `System.Address`. It will be interpreted as an absolute machine address, using the segment part as a selector if in the protected mode. It is the user's responsibility to ensure that the value given makes sense (i.e., points at memory, does not overlay other objects, etc.) No other address clauses are supported.

F.5 Implementation Defined Names

JANUS/Ada uses no implementation generated names.

F.6 Address Clause Expressions

The address given for an object address clause may be any legal value of type `System.Address`. It will be interpreted as an absolute machine address, using the segment part as a selector if in the protected mode. It is the user's responsibility to ensure that the value given makes sense (i.e., points at memory, does not overlay other objects, etc.)

F.7 Unchecked_Conversion Restrictions

We first make the following definitions:

A type or subtype is said to be a *simple type* or a *simple subtype* (respectively) if it is a scalar (sub)type, an access (sub)type, a task (sub)type, or if it satisfies the following two conditions:

- 1) If it is an array type or subtype, then it is constrained and its index constraint is static; and
- 2) If it is a composite type or subtype, then all of its subcomponents have a simple subtype.

A (sub)type which does not meet these conditions is called *non-simple*. Discriminated records can be simple; variant records can be simple. However, constraints which depend on discriminants are non-simple (because they are non-static).

JANUS/Ada imposes the following restriction on instantiations of `Unchecked_Conversion`: for such an instantiation to be legal, both the source

actual subtype and the target actual subtype must be simple subtypes, and they must have the same size.

F.8 Implementation Dependencies of I/O

The syntax of an external file name depends on the operating system being used. Some external files do not really specify disk files; these are called *devices*. Devices are specified by special file names, and are treated specially by some of the I/O routines.

The syntax of an MS-DOS 2.xx or 3.xx filename is:

[d:][path]filename[.ext]

where "d:" is an optional disk name; "path" is an optional path consisting of directory names, each followed by a backslash; "filename" is the filename (maximum 8 characters); and ".ext" is the extension (or file type). See your MS-DOS manual for a complete description. In addition, the following special device names are recognized:

- STI: MS-DOS standard input. The same as Standard_Input. Input is buffered by lines, and all MS-DOS line editing characters may be used. Can only be read.
- STO: MS-DOS standard output. The same as Standard_Output. Can only be written.
- ERR: MS-DOS standard error. The output to this device cannot be redirected. Can only be written.
- CON: The console device. Single character input with echoing. Due to the design of MS-DOS, this device *can* be redirected. Can be read and written.
- AUX: The auxiliary device. Can be read or written.
- LST: The list (printer) device. Can only be written.
- KED: The console input device. No character interpretation is performed, and there is no character echo. Again, the input to this device can be redirected, so it does not *always* refer to the physical keyboard.

The MS-DOS device files may also be used (CON, AUX, and PRN without colons ':'). For compatibility reasons, we do not recommend the use of these names.

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The MS-DOS 2.xx version of the I/O system will do a search of the default search path (set by the DOS PATH command) if the following conditions are met:

- 1) No disk name or path is present in the file name; and
- 2) The name is not that of a device.

Alternatively, you may think of the search being done if the file name does not contain any of the characters ':', '/', or '\'.

The default search path cannot be changed while the program is running, as the path is copied by the JANUS/Ada program when it starts running.

Note:

Creates will never cause a path search as they must work in the current directory.

Upon normal completion of a program, any open external files are closed. Nevertheless, to provide portability, we recommend explicitly closing any files that are used.

Sharing external files between multiple file objects causes the corresponding external file to be opened multiple times by the operating system. The effects of this are defined by your operating system. This external file sharing is only allowed if all internal files associated with a single external file are opened only for reading (mode `In_File`), and no internal file is `Created`. `Use_Error` is raised if these requirements are violated. A `Reset` to a writing mode of a file already opened for reading also raise `Use_Error` if the external file also is shared by another internal file.

Binary I/O of values of access types will give meaningless results and should not be done. Binary I/O of types which are not simple types (see definition in Section F.7, above) will raise `Use_Error` when the file is opened. Such types require specification of the block size in the form, a capability which is not yet supported.

The form parameter for `Sequential_IO` and `Direct_IO` is always expected to be the null string.

The type `Count` in the generic package `Direct_IO` is defined to have the range 0 .. 32767.

Ada specifies the existence of special markers called *terminators* in a text file. JANUS/Ada defines the line terminator to be `<LF>` (line feed), with or without an

additional <CR> (carriage return). The page terminator is the <FF> (form feed) character; if it is not preceded by a <LF>, a line terminator is also assumed.

The file terminator is the end-of-file returned by the host operating system. If no line and/or page terminator directly precedes the file terminator, they are assumed. If the form "Z" is used, the <Ctrl>-Z character also represents the end-of-file. This form is not necessary to correctly read files produced with JANUS/Ada and most other programs, but may be occasionally necessary. The only legal forms for text files are "" (the null string) and "Z". All other forms raise `USE_ERROR`.

If the form is "", the <Ctrl>-Z character is ignored on input. The <CR> character is always ignored on input. (They will *not* be returned by `Get`, for instance). All other control characters are sent directly to the user. Output of control characters does not affect the layout that `Text_IO` generates. In particular, output of a <LF> before a `New_Page` does not suppress the `New_Line` caused by the `New_Page`.

On output, the "Z" form causes the end-of-file to be marked by a <Ctrl>-Z; otherwise, no explicit end-of-file character is used. The character pair <CR> <LF> is written to represent the line terminator. Because <CR> is ignored on input, this is compatible with input.

The type `Text_IO.Count` has the range 0 .. 32767; the type `Text_IO.Field` also has the range 0 .. 32767.

`IO_Exceptions.USE_ERROR` is raised if something cannot be done because of the external file system; such situations arise when one attempts:

- to create or open an external file for writing when the external file is already open (via a different internal file).
- to create or open an external file when the external file is already open for writing (via a different internal file).
- to reset a file to a writing mode when the external file is already open (via a different internal file).
- to write to a full disk (`Write`, `Close`);
- to create a file in a full directory (`Create`);
- to have more files open than the OS allows (`Open`, `Create`);
- to open a device with an illegal mode;
- to create, reset, or delete a device;
- to create a file where a protected file (i.e., a directory or read-only file) already exists;
- to delete a protected file;
- to use an illegal form (`Open`, `Create`); or
- to open a file for a non-simple type without specifying the block size;
- to open a device for direct I/O.

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IO_Exceptions.DEVICE_ERROR is raised if a hardware error other than those covered by USE_ERROR occurs. These situations should never occur, but may on rare occasions. For example, DEVICE_ERROR is raised when:

- a file is not found in a Close or a Delete;
- a seek error occurs on a direct Read or Write; or
- a seek error occurs on a sequential End_Of_File.

The subtypes Standard.Positive and Standard.Natural, used by some I/O routines, have the maximum value 32767.

No package Low_Level_IO is provided.

F.9 Running the compiler and linker

The JANUS/Ada compiler is invoked using the following format:

```
JANUS [d:] filename [.ext] [/option]
```

where filename is an MS/DOS file name with optional disk name [d:], optional extension [.ext], and compiler options [/option]. If no disk name is specified, the current disk is assumed. If no extension is specified, .PKG is assumed.

The compiler options are:

- B Brief error messages. The line in error is not printed (equivalent to turning off pragma VERBOSE).
- D Don't generate debugging code (equivalent to turning off pragma DEBUG)
- F Use in-line 8087 instructions for Floating point operations. By default the compiler generates library calls for floating point operations. The 8087 may be used to execute the library calls. A floating point support library is still required, even though this option is used.
- L Create a listing file with name filename.PRN on the same disk as filename. The listing file will be a listing of only the last compilation unit in a file.
- Ld Create a listing file on specified disk 'd'. Choices are 'A' through 'W'.
- Ox Object code memory model. X is 0 or 1. Memory model 0 creates faster, smaller code, but limits all code in all units of a program to one MS-DOS segment (i.e., 64 kilobytes); Memory model 1 allows code size limited only by your machine and operating system. See the linker (JLINK) manual for more information. Memory model 0 is assumed if this option is not given. The compiler records the memory model for which each library unit was compiled, and it will complain if any mismatches occur. Thus, the compiler enforces that if it is run using the /ol option, then all of the withed units must have been compiled with the same option.

- Q** Quiet error messages. This option causes the compiler not to wait for the user to interact after an error. In the usual mode, the compiler will prompt the user after each error to ask if the compilation should be aborted. This option is useful if the user wants to take a coffee break while the compiler is working, since all user prompts are suppressed. The errors (if any) will not stay on the screen when this option is used; therefore, the console traffic should be sent to the printer or to a file. Be warned that certain syntax errors can cause the compiler to print many error messages for each and every line in the program. A lot of paper could be used this way! Note that the /Q option disallows disk swapping, even if the /S option is given.
- Rd** Route the JRL file to the specified disk 'd'. Choices are 'A' through 'W'. The default is the same disk as filename.
- Sd** Route Scratch files to specified disk. This option is useful if you have a RAM disk or if your disk does not have much free space. The use of this option also allows disk swapping to load package specification (.SYM) files. Normally, after both the compiler and source file disks are searched for .SYM files, an error is produced if they are not all found. However, when the /S option is used, the compiler disk may be removed and replaced by a disk to search. The linker has a similar option, which allows the development of large programs on systems with a small disk capacity. Note that disk swapping is *not* enabled by the /S option if the /Q (quiet option) is also given. The /Q option is intended for batch mode compiles, and its purpose conflicts with the disk swapping. The main problem is that when the /S option is used to put scratch files on a RAM disk, a batch file may stop waiting for a missing .SYM or ERROR.MSG file; such behavior would not be appropriate when /Q is specified.
- T** Generate information which allows trimming unused subprograms from the code. This option tells the compiler to generate information which can be used by the remove subprograms from the final code. This option increases the size of the .JRL files produced. We recommend that it be used on reusable libraries of code (like trig. libraries or stack packages) - that is these compilations for which it is likely that some subprograms are not called.
- W** Don't print any warning messages. For more control of warning messages, use the following option form (Wx).
- Wx** Print only warnings of level less than the specified digit 'x'. The given value of x may be from 1 to 9. The more warnings you are willing to see, the higher the number you should give.
- X** Handle eXtra symbol table information. This option is for the use of the JScope debugger and other tools. This option requires large quantities of memory and disk space, and thus should be avoided if possible.
- Z** Turn on optimization. This has the same effect as if the pragma OPTIMIZE were set to SPACE throughout your compilation.

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The default values for the command line options are:

B Error messages are verbose.
D Debug code is generated.
F Library calls are generated for floating point operations.
L No listing file is generated.
O Memory model 0 is used.
Q The compiler prompts for abort after every error.
R The JRL file is put on the same disk as the input file.
S Scratch files are put on the same disk as the compiler.
T No trimming code is produced.
W All warnings are printed.
X Extra symbol table information is not generated.
Z Optimization is done only where so specified by pragmas.

Leading spaces are disregarded between the filename and the call to JANUS. Spaces are otherwise not recommended on the command line. The presence of blanks to separate the options or between the filename and the extension will be ignored.

Examples:

```
JANUS test/Q/L
JANUS test.run/W4
JANUS test
JANUS test .run /B /W/L
```

The compiler produces a SYM (SYMBOL table information) file when a specification is compiled, and a SRL or JRL (Specification ReLocatable or Janus ReLocatable) file when a body is compiled. To make an executable program, the appropriate SRL and JRL files must be *linked* (combined) with the run-time libraries. This is accomplished by running the JANUS'Ada linker, JLINK.

The JANUS'Ada linker is invoked using the following format:

```
JLINK [d:] filename [/option]
```

Here "filename" is the name of the SRL or JRL file created when the main program was compiled (without the .SRL or .JRL extension) with optional disk name [d:], and compiler options [/option]. The filename usually corresponds to the first eight letters of the name of your main program. A disk may be specified where the files are to be found. See the linker manual for more detailed directions. We summarize here, however, a few of the most commonly used linking options:

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- E Create an EXE file. This is assumed if the /O1 option is given. This allows allow a slightly larger total program size if memory model is used.
- F0 Use software floating point (the default).
- F2 Use hardware (8087) floating point.
- L Display lots of information about the loading process.
- O0 Use memory model 0 (the default); see the description of the /O option in the compiler, above.
- O1 Use memory model 1.
- Q Use quiet error messages; i.e., don't wait for the user to interact after an error.
- T Trim unused subprograms from the code. This option tells the linker to remove subprograms which are never called from the final output file. This option reduces space usage of the final file by as much as 30K.

Examples:

```
JLINK test
JLINK test /Q/L
JLINK test/O1/L/F2
```

Note that if you do not have a hardware floating point chip, and if you are using memory model 0, then you generally will not need to use any linker options.

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TEST PARAMETERS

| <u>Name and Meaning</u> | <u>Value</u> |
|--|---|
| <p>\$BIG_ID4 An identifier the size of the maximum input line length which is identical to \$BIG_ID3 except for a character near the middle.</p> | 1..99 => 'A', 100 => '4', 101..200 => 'A' |
| <p>\$BIG_INT_LIT An integer literal of value 298 with enough leading zeroes so that it is the size of the maximum line length.</p> | 1..197 => '0', 198..200 => "298" |
| <p>\$BIG_REAL_LIT A universal real literal of value 690.0 with enough leading zeroes to be the size of the maximum line length.</p> | 1..194 => '0', 195..200 => "69.0E1" |
| <p>\$BIG_STRING1 A string literal which when catenated with BIG_STRING2 yields the image of BIG_ID1.</p> | 1 => '"', 2..101 => 'A', 102 => '"' |
| <p>\$BIG_STRING2 A string literal which when catenated to the end of BIG_STRING1 yields the image of BIG_ID1.</p> | 1 => '"', 2..100 => 'A', 101 => '1', 102 => '"' |
| <p>\$BLANKS A sequence of blanks twenty characters less than the size of the maximum line length.</p> | 1..180 => ' ' |
| <p>\$COUNT_LAST A universal integer literal whose value is TEXT_IO.COUNT'LAST.</p> | 32_767 |
| <p>\$DEFAULT_MEM_SIZE An integer literal whose value is SYSTEM.MEMORY_SIZE.</p> | 65536 |
| <p>\$DEFAULT_STOR_UNIT An integer literal whose value is SYSTEM.STORAGE_UNIT.</p> | 8 |

TEST PARAMETERS

| <u>Name and Meaning</u> | <u>Value</u> |
|--|---|
| <p>\$DEFAULT_SYS_NAME The value of the constant SYSTEM.SYSTEM_NAME.</p> | MS_DOS2 |
| <p>\$DELTA_DOC A real literal whose value is SYSTEM.FINE_DELTA.</p> | 0.000_000_000_465_661_287_307_739_257_812_5 |
| <p>\$FIELD_LAST A universal integer literal whose value is TEXT_IO.FIELD'LAST.</p> | 32_767 |
| <p>\$FIXED_NAME The name of a predefined fixed-point type other than DURATION.</p> | NOT_APPLICABLE |
| <p>\$FLOAT_NAME The name of a predefined floating-point type other than FLOAT, SHORT_FLOAT, or LONG_FLOAT.</p> | NOT_APPLICABLE |
| <p>\$GREATER_THAN_DURATION A universal real literal that lies between DURATION'BASE'LAST and DURATION'LAST or any value in the range of DURATION.</p> | 300_000.0 |
| <p>\$GREATER_THAN_DURATION_BASE_LAST A universal real literal that is greater than DURATION'BASE'LAST.</p> | 1.0E6 |
| <p>\$HIGH_PRIORITY An integer literal whose value is the upper bound of the range for the subtype SYSTEM.PRIORITY.</p> | 0 |
| <p>\$ILLEGAL_EXTERNAL_FILE_NAME1 An external file name which contains invalid characters.</p> | \NODIRECTORY\FILENAME |
| <p>\$ILLEGAL_EXTERNAL_FILE_NAME2 An external file name which is too long.</p> | <BAD ^^> |
| <p>\$INTEGER_FIRST A universal integer literal whose value is INTEGER'FIRST.</p> | -32768 |

TEST PARAMETERS

| <u>Name and Meaning</u> | <u>Value</u> |
|---|---|
| \$INTEGER_LAST A universal integer literal whose value is INTEGER'LAST. | 32767 |
| \$INTEGER_LAST_PLUS_1 A universal integer literal whose value is INTEGER'LAST + 1. | 32768 |
| \$LESS_THAN_DURATION A universal real literal that lies between DURATION'BASE'FIRST and DURATION'FIRST or any value in the range of DURATION. | -305_000.0 |
| \$LESS_THAN_DURATION_BASE_FIRST A universal real literal that is less than DURATION'BASE'FIRST. | -1.0E6 |
| \$LOW_PRIORITY An integer literal whose value is the lower bound of the range for the subtype SYSTEM.PRIORITY. | 0 |
| \$MANTISSA_DOC An integer literal whose value is SYSTEM.MAX_MANTISSA. | 31 |
| \$MAX_DIGITS Maximum digits supported for floating-point types. | 15 |
| \$MAX_IN_LEN Maximum input line length permitted by the implementation. | 200 |
| \$MAX_INT A universal integer literal whose value is SYSTEM.MAX_INT. | 2147483647 |
| \$MAX_INT_PLUS_1 A universal integer literal whose value is SYSTEM.MAX_INT+1. | 2147483648 |
| \$MAX_LEN_INT_BASED_LITERAL A universal integer based literal whose value is 2#11# with enough leading zeroes in the mantissa to be MAX_IN_LEN long. | 1..2 => "2:", 3..197 => '0', 198..200 => "11:" |

TEST PARAMETERS

| <u>Name and Meaning</u> | <u>Value</u> |
|--|---|
| <p>\$MAX_LEN_REAL_BASED_LITERAL A universal real based literal whose value is 16:F.E: with enough leading zeroes in the mantissa to be MAX_IN_LEN long.</p> | <p>1..3 => "16:", 4..196 => '0', 197..200 => "F.E:"</p> |
| <p>\$MAX_STRING_LITERAL A string literal of size MAX_IN_LEN, including the quote characters.</p> | <p>1 => '"', 2..199 => 'A', 200 => ''</p> |
| <p>\$MIN_INT A universal integer literal whose value is SYSTEM.MIN_INT.</p> | <p>-2147483648</p> |
| <p>\$MIN_TASK_SIZE An integer literal whose value is the number of bits required to hold a task object which has no entries, no declarations, and "NULL;" as the only statement in its body.</p> | <p>16</p> |
| <p>\$NAME A name of a predefined numeric type other than FLOAT, INTEGER, SHORT_FLOAT, SHORT_INTEGER, LONG_FLOAT, or LONG_INTEGER.</p> | <p>NOT_APPLICABLE</p> |
| <p>\$NAME_LIST A list of enumeration literals in the type SYSTEM.NAME, separated by commas.</p> | <p>MS_DOS2</p> |
| <p>\$NEG_BASED_INT A based integer literal whose highest order nonzero bit falls in the sign bit position of the representation for SYSTEM.MAX_INT.</p> | <p>16#FFFF_FFFF#</p> |
| <p>\$NEW_MEM_SIZE An integer literal whose value is a permitted argument for pragma MEMORY_SIZE, other than \$DEFAULT_MEM_SIZE. If there is no other value, then use \$DEFAULT_MEM_SIZE.</p> | <p>65536</p> |

TEST PARAMETERS

| <u>Name and Meaning</u> | <u>Value</u> |
|--|--------------|
| <u>\$NEW_STOR_UNIT</u> An integer literal whose value is a permitted argument for pragma STORAGE_UNIT, other than \$DEFAULT_STOR_UNIT. If there is no other permitted value, then use value of SYSTEM.STORAGE_UNIT. | 8 |
| <u>\$NEW_SYS_NAME</u> A value of the type SYSTEM.NAME, other than \$DEFAULT_SYS_NAME. If there is only one value of that type, then use that value. | MS_DOS2 |
| <u>\$TASK_SIZE</u> An integer literal whose value is the number of bits required to hold a task object which has a single entry with one 'IN OUT' parameter. | 16 |
| <u>\$TICK</u> A real literal whose value is SYSTEM.TICK. | 0.01 |

APPENDIX D
WITHDRAWN TESTS

Some tests are withdrawn from the ACVC because they do not conform to the Ada Standard. The following 36 tests had been withdrawn at the time of validation testing for the reasons indicated. A reference of the form AI-ddddd is to an Ada Commentary.

- a. A39005G has been withdrawn because it unreasonably expects a component clause to pack an array component into a minimum size (line 30).
- b. B97102E has been withdrawn because it contains an unintended illegality: a select statement contains a null statement at the place of a selective wait alternative (line 31).
- c. BC3009B has been withdrawn because it wrongly expects that circular instantiations will be detected in several compilation units even though none of the units is illegal with respect to the units it depends on; by AI-00256, the illegality need not be detected until execution is attempted (line 95).
- d. CD2A62D has been withdrawn because it wrongly requires that an array object's size be no greater than 10, although its subtype's size was specified to be 40 (line 137).
- e. CD2A63A..D, CD2A66A..D, CD2A73A..D, CD2A76A..D [16 tests] have been withdrawn because they wrongly attempt to check the size of objects of a derived type (for which a 'SIZE length clause is given) by passing them to a derived sub-program (which implicitly converts them to the parent type (Ada standard 3.4:14)). Additionally, they use the 'SIZE length clause and attribute, whose interpretation is considered problematic by the WG9 ARG.
- f. CD2A81G, CD2A83G, CD2A84M and N, and CD50110 have been withdrawn because they assume that dependent tasks will terminate while the main program executes a loop that simply tests for task termination; this is not the case, and the main program may loop indefinitely (lines 74, 85, 86 and 96, 86 and 96, and 58,

WITHDRAWN TESTS

respectively).

- g. CD2B15C and CD7205C have been withdrawn because they expect that a 'STORAGE_SIZE length clause provides precise control over the number of designated objects in a collection; the Ada standard 13.2:15 allows that such control must not be expected.
- h. CD5007B has been withdrawn because it wrongly expects an implicitly declared subprogram to be at the the address that is specified for an unrelated subprogram (line 303).
- i. CD7105A has been withdrawn because it requires that successive calls to CALENDAR.CLOCK change by at least SYSTEM.TICK; however, by Commentary AI-00201, it is only the expected frequency of change that must be at least SYSTEM.TICK--particular instances of change may be less (line 29).
- j. CD7203B and CD7204B have been withdrawn because they use the 'SIZE length clause and attribute, whose interpretation is considered problematic by the WG9 ARG.
- k. CD7205D has been withdrawn because it checks an invalid test objective: it treats the specification of storage to be reserved for a task's activation as though it were like the specification of storage for a collection.
- l. CE2107I has been withdrawn because it requires that objects of two similar scalar types be distinguished when read from a file--DATA_ERROR is expected to be raised by an attempt to read one object as of the other type. However, it is not clear exactly how the Ada standard 14.2.4:4 is to be interpreted; thus, this test objective is not considered valid. (line 90)
- m. CE3111C has been withdrawn because it requires certain behavior when two files are associated with the same external file; however, this is not required by the Ada standard.
- n. CE3301A has been withdrawn because it contains several calls to END_OF_LINE and END_OF_PAGE that have no parameter: these calls were intended to specify a file, not to refer to STANDARD_INPUT (lines 103, 107, 118, 132, and 136).
- o. CE3411B has been withdrawn because it requires that a text file's column number be set to COUNT'LAST in order to check that LAYOUT_ERROR is raised by a subsequent PUT operation. But the former operation will generally raise an exception due to a lack of available disk space, and the test would thus encumber validation testing.